Complementary and Alternative Medicine Use and Adherence With Pediatric Asthma Treatment

WHAT'S KNOWN ON THIS SUBJECT: Complementary and alternative medicine (CAM) use for pediatric asthma is increasing. It is well known that effective asthma management depends on patient adherence to treatment. The authors of previous cross-sectional studies have linked CAM use with decreased adherence to conventional asthma treatment regimens.

WHAT THIS STUDY ADDS: This longitudinal data set was unique, allowing us to focus on patients who initiated CAM and to follow subsequent asthma medication adherence. We found that CAM use was not associated with adherence, suggesting that patients may practice CAM alongside conventional therapies.

abstract

FREE

BACKGROUND AND OBJECTIVE: Complementary and alternative medicine (CAM) use for pediatric asthma is increasing. The authors of previous studies linked CAM use with decreased adherence to conventional asthma medicines; however, these studies were limited by cross-sectional design. Our objective was to assess the effect of starting CAM on pediatric adherence with daily asthma medications.

METHODS: We used a retrospective cohort study design. Telephone surveys were administered to caregivers of patients with asthma annually from 2004 to 2007. Dependent variables were percent missed doses per week and a previously validated "Medication Adherence Scale score." Independent variables included demographic factors, caregiver perception of asthma control, and initiation of CAM for asthma. We used multivariate linear regression to assess the relationship between medication adherence and previous initiation of CAM.

RESULTS: From our longitudinal data set of 1322 patients, we focused on 187 children prescribed daily medications for all 3 years of our study. Patients had high rates of adherence. The mean percent missed asthma daily controller medication doses per week was 7.7% (SD = 14.2%). Medication Adherence Scale scores (range: 4–20, with lower scores reflecting higher adherence) had an overall mean of 7.5 (SD = 2.9). In multivariate analyses, controlling for demographic factors and asthma severity, initiation of CAM use was not associated with subsequent adherence ($P > .05$).

CONCLUSIONS: The data from this study suggest that CAM use is not necessarily "competitive" with conventional asthma therapies; families may incorporate different health belief systems simultaneously in their asthma management. As CAM use becomes more prevalent, it is important for physicians to ask about CAM use in a nonjudgmental fashion. *Pediatrics* 2012;129:e1148–e1154

AUTHORS: Julie C. Philp, MD,[a,b] Judy Maselli, MSPH,[c] Lee M. Pachter, DO,[d] and Michael D. Cabana, MD, MPH[b,c,e]

Departments of [a]Dermatology, [b]Pediatrics, and [c]Epidemiology and Biostatistics, [e]The Philip R. Lee Institute for Health Policy Studies, University of California, San Francisco School of Medicine, San Francisco, California; and [d]Department of Pediatrics, St. Christopher's Hospital for Children and Drexel University College of Medicine, Philadelphia, Pennsylvania

KEY WORDS
alternative medicine, adherence, asthma

ABBREVIATIONS
CAM—complementary and alternative medicine
CI—confidence interval

www.pediatrics.org/cgi/doi/10.1542/peds.2011-2467

doi:10.1542/peds.2011-2467

Accepted for publication Dec 22, 2011

Address correspondence to Julie C. Philp, MD, Divisions of Pediatrics and Dermatology, 1701 Divisadero St, 3rd Floor, San Francisco, CA 94143. E-mail: philpj@derm.ucsf.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

FUNDING: Funded by the American Academy of Pediatrics Resident Research Grant Program, National Heart, Lung and Blood Institute (HL070771).

Complementary and alternative medicine (CAM) is defined as health care practices that are usually not included in conventional biomedical systems.[1] CAM encompasses a variety of therapies such as herbal remedies, acupuncture, and homeopathy. According to a recent survey performed by the Centers for Disease Control and Prevention, ~40% of adults and 12% of children used CAM.[2] The most recent estimate of annual expenditure on CAM among children was $149 million in 1996.[3]

CAM use is increasing in prevalence among children,[4] and studies have revealed higher rates among children with respiratory complaints.[5,6] It is therefore important to understand the effect of CAM use on patient adherence with conventional asthma therapy, if any. For example, when children start using CAM, do they become less adherent with their conventional treatment? It is well established that effective treatment of asthma is reliant upon patient adherence to daily treatment regimens.[7] Adherence to asthma medication regimens among children and adults is variable, with reported rates between 30% and 70%.[8,9]

Studies have suggested a link between parental beliefs about medications and their child's adherence to asthma treatment.[10–14] Child adherence was revealed to decrease as parental concerns about medications exceeded their belief in the necessity of the medications.[10] Parental concerns about asthma medications were linked to increased CAM use.[15] One might deduce, consequently, that CAM use could be associated with decreased adherence to asthma treatment. Studies have suggested that parents who use CAM may use it in place of biomedical asthma medications.[16–18] Similarly, herbal remedy use has been linked to decreased adherence with asthma medications among adults.[19] However, these studies were limited by cross-sectional design.

In the current study, we conducted interviews with caregivers of children with asthma to understand the relationship between CAM use and adherence with daily asthma medications. The objective of the study was to assess the effect of starting CAM on adherence with daily asthma medications among pediatric patients. The longitudinal nature of this data set was unique and allowed us to focus on a specific group of patients who initiated CAM and follow subsequent asthma medication adherence patterns.

METHODS

We used a retrospective cohort study design to analyze the effect of CAM use on adherence to conventional asthma medications. In this posthoc analysis, we used longitudinal data from a randomized clinical trial designed to evaluate the effect of physician asthma education on management of asthma. The study protocol was approved by the institutional review boards at the University of Michigan and the University of California, San Francisco. This data set has also been used in the analysis of parental attitudes toward asthma management, in the analysis of demographic factors associated with CAM use in pediatric patients, and in the validation of a "Beliefs in Medications" questionnaire.[10,15]

Patient Population

A cohort of 1322 patients of 1858 potentially eligible respondents (71.2% response rate) was developed from 40 pediatricians in rural, urban, and suburban Michigan. Eligibility criteria included having a diagnosis of asthma, having used health care services in the previous 2 years, and being between the ages of 2 and 16 years. Exclusion criteria included having a disease involving pulmonary complications (eg, cystic fibrosis) or having a caregiver who worked for a study physician. We included only 1 child per family.

Because adherence to daily asthma medication was an outcome variable for the current study, only patients who took daily asthma medications (corticosteroids, leukotriene modifiers, long-acting β-agonists, and combination medications) were included in the analysis. After excluding patients who did not take daily asthma medications for all 3 consecutive years of the study, there were 187 patients used for analyses.

Data Collection

Trained interviewers administered the telephone surveys to caregivers at yearly intervals between 2004 and 2007. Surveys covered an array of topics including asthma symptoms, caregiver concerns about medications, asthma severity, and CAM use and adherence. The survey was administered as part of a larger study about physician education and asthma management; caregivers were thus not aware that questions about CAM use and medication adherence would be analyzed together. Caregivers were asked to provide demographic information including patient and caregiver age, patient gender, caregiver ethnicity, place of caregiver birth, total annual combined household income, number of persons dependent on income, caregiver education, and primary language at home.

To determine asthma severity, caregivers were asked about frequency of symptoms that interfered with sleep or with physical activity over the past month. To assess caregiver perception of asthma control, caregivers were asked to rate asthma control over the past month on a scale of 1 to 5, where 1 was "not controlled at all" and 5 was "very controlled."

To assess the use of CAM, caregivers were asked the following: "In the past 12 months, have you used alternative home remedies including herbs, teas, dietary changes, breathing exercises,

meditation, prayer, massage, biofeedback, or homeopathy to control [the patient's] asthma symptoms?" Caregiver responses were recorded verbatim then categorized by using the National Institutes of Health National Center for Complementary and Alternative Medicine classification system. These categories were alternative medical systems (eg, homeopathy), mind-body interventions (eg, imagery), biologically based therapies (eg, herbs), manipulative and body-based therapies (eg, massage and chiropractics), and energy therapies (eg, healing touch). Some responses were consistent with conventional asthma therapies and were thus excluded (use of air filters, allergen avoidance, etc).

The survey included 2 measures of adherence. For the first adherence measure, caregivers were asked how many times a week the child was supposed to take their asthma medication and how many doses were missed per week. For the second adherence measure, a 4-item "Medication Adherence Scale" was used.[13] Previous studies have revealed this scale to have good reliability in adults with chronic diseases (Cronbach's α = 0.60–0.83)[20] and in urban children with asthma (Cronbach's α = 0.78).[21] The scale includes questions based on a 5-point likert scale, such as "I sometimes alter the dose of my child's medication to suit their needs" and "Some people forget to give their child his/her medications, how often does this happen to you?"

Variables

Our dependent variables were adherence with daily asthma medications as defined by our 2 adherence measures. The first adherence variable was "percent missed doses" (number of doses missed in a week divided by number of doses the child was supposed to take in a week). The second adherence variable was the Medication Adherence Scale score, which was the sum of scores from 4 separate 5-point questions. Thus, the final adherence scores ranged from 4 to 20, with lower scores indicating better adherence.

Independent variables included patient characteristics (age, gender, and severity of asthma), caregiver perception of the child's asthma control, caregiver characteristics (age, race, place of birth, income, and education level), and use of any type of CAM. We subdivided CAM use into the following 2 groups: patients who did not use CAM at the beginning of the study (year 0) and who started using CAM during the first year of the study (year 1) versus patients who did not use CAM at the beginning of the study (year 0) and who continued to not use CAM during the first year of the study (year 1). Patients who were using CAM both at baseline and during year 1 of the study were not included because the study was designed to evaluate the effects of starting to use CAM on subsequent adherence.

We divided age of child into 3 categories (ages 4–7, ages 8–12, and ages 13–19) based on the age at which children tended to start administering their own medications in our data set[22] and the age of adolescence because previous studies have revealed decreased adherence during adolescence.[23–25] We dichotomized caregiver age into 2 categories, 28 to 42 years old and 43 to 59 years old based on the distribution of ages in our data set. We dichotomized caregiver education into 2 categories, "college graduate" versus "noncollege graduate." We collapsed the variable for ethnicity into "white" and "nonwhite," the variable for primary language into "English" and "non-English," and the variable for place of caregiver birth into "United States" and "foreign country." We used the 2006 definition of poverty published by the US Department of Health and Human Services to determine 6 categories for household income.

Based on National Heart, Lung, and Blood Institute guidelines, we categorized patients as having persistent or intermittent asthma. "Persistent" asthma was defined as daytime symptoms 9 or more times in the preceding month or nighttime symptoms 2 or more times in the preceding month. Patients with less frequent symptoms were classified as having "intermittent" asthma.

Based on inspection of the data, we dichotomized the level of caregiver perception of their child's asthma control into 2 categories, "not controlled," if they rated the child's asthma control as 1 to 3 versus "controlled," if they chose 4 or 5.

Analysis

We used SAS version 9.1 software (SAS Institute, Cary, NC). Statistical significance was defined as $P < .05$. Analyses were performed on survey data from baseline (year 0), year 1, and year 2. We determined that 3 years of data were needed; the first 2 years were needed to examine if a CAM medication was started, the third year was needed to determine if there was a change in medication adherence compared with previous years.

Demographic characteristics of the 187 children included in the study are displayed in Table 1. The relationship between adherence measures and demographic factors, caregiver perception of asthma control, and asthma severity is shown in Table 2. We performed bivariate analyses by using the Wilcoxon rank sum test to assess for differences in adherence during year 1 according to demographic factors at baseline (year 0) such as child gender; child age; primary language at home; household income relative to the poverty line; and caregiver race, age, place of birth, and education. Bivariate analyses using the Wilcoxon rank sum test were also performed to

TABLE 1 Population Characteristics (N = 187)

Characteristics[a]	N (%)
Child gender	
Boy, n = 130	130 (70)
Girl, n = 57	57 (30)
Child age, y	
4–7	58 (31)
8–12	82 (44)
13–19	47 (25)
Caregiver age, y[a]	
28–42	79 (42)
43–59	105 (56)
Caregiver race	
White	163 (87)
Nonwhite	24 (13)
Caregiver education[a]	
Noncollege graduate	71 (38)
College graduate	114 (61)
Primary language at home[a]	
English	183 (98)
Non-English	3 (2)
Place of caregiver birth[a]	
US born	175 (94)
Foreign born	10 (5)
Caregiver income[a]	
≤ poverty line	8 (4)
≤2× poverty line	11 (6)
≤3× poverty line	20 (11)
≤4× poverty line	28 (15)
≤5× poverty line	26 (14)
>5× poverty line	60 (32)
Child severity of asthma	
Persistent	57 (30)
Intermittent	130 (70)
Caregiver perception of asthma control	
Controlled	161 (86)
Not controlled	26 (14)
CAM use	
Used CAM	34 (18)
Did not use CAM	153 (82)

[a] Data unavailable for some patients.

assess for differences in adherence during year 1 according to caregiver's perception of asthma control and child severity of asthma at year 1.

We performed a multivariate linear regression to assess the relationship between medication adherence during year 2 of the study (measured as a continuous variable) and the initiation of CAM or adding a new CAM modality between year 0 and year 1 of the study (Table 3). Because our data were right skewed (toward higher adherence scores), the adherence outcomes were analyzed by using generalized linear models for the γ distribution, with log link function, as implemented in Proc Genmod in SAS. The model adjusted for the following factors: clustering of responses by provider, intervention versus control status in original study, and severity of asthma.

RESULTS

Participants

Participants were caregivers of children who were prescribed a daily asthma medication during all 3 years of the study (n = 187). Thirty-one percent of children were between 4 and 7 years old, 44% were between 8 and 12 years old, and 25% were between 13 and 19 years old; 70% were boys. The sample was predominantly white (87%). Sixty-one percent were college educated. Approximately 10% had an annual household income less than or equal to twice the federal poverty level. Thirty percent of children had persistent asthma, and 86% of caregivers felt their child's asthma was well controlled (Table 1).

Overall, 18% of patients used CAM in our cohort. In a previous study, we analyzed which CAM modalities were used by the patients.[26] Forty-two percent used biologically based therapies (vitamins, herbs, oils, etc), 39% used mind-body interventions (breathing exercises, prayer, relaxation, etc), 13% used manipulative and body based therapies (chiropractor, massage, etc), and 6% used homeopathy.

TABLE 2 Adherence Measures in Relation to Demographic Factors (N = 187)

Variable	Adherence Score (4–20)[a]		% Missed Doses/Week	
	Mean (SD), Median (IQR)	P[b]	Mean, Median (IQR)	P[b]
Child gender				
Boy, n = 130	7.6 (2.9), 7 (5–9)	.39	7.6, 0 (0–0.14)	.78
Girl, n = 57	7.2 (2.9), 6 (5–9)		7.8, 0 (0–0.11)	
Child age, y				
4–7, n = 58	6.9 (2.6), 6 (5–8)	.17	6.9, 0 (0–0.10)	.30
8–12, n = 82	7.9 (3.0), 8 (6–9)		6.9, 0 (0–0.14)	
13–19, n = 47	7.4 (3.1), 6 (5–10)		9.9, 0.03 (0–0.14)	
Caregiver age, y				
28–42, n = 79	7.6 (3.0), 7 (5–10)	.68	6, 0 (0–0.10)	.06
43–59, n = 105	7.4 (2.8), 7 (5–9)		10, 0 (0–0.14)	
Caregiver race				
White, n = 163	7.4 (2.9), 7 (5–9)	.54	7.5, 0 (0–0.11)	.22
Nonwhite, n = 24	7.9 (3.3), 8 (5–11)		8.7, 0.02 (0–0.16)	
Caregiver education				
Noncollege graduate, n = 71	7.3 (2.7), 7 (5–9)	.81	8.3, 0 (0–0.14)	.39
College graduate, n = 114	7.6 (3.1), 7 (5–10)		7.4, 0 (0–0.14)	
Primary language at home				
English, n = 183	7.5 (2.9), 7 (5–9)	.88	7.9, 0 (0–0.14)	.17
Non-English, n = 3	7.3 (2.1), 8 (5–9)		0, 0 (0–0)	
Place of caregiver birth				
United States, n = 175	7.5 (3.0), 7 (5–9)	.53	8.1, 0 (0–0.14)	.13
Foreign, n = 10	6.7 (2.0), 7 (5–8)		2.1, 0 (0–0)	
Caregiver income				
≤ poverty line, n = 8	6.5 (2.8), 6 (4–8)	.05	3.1, 0 (0–0.05)	.13
≤2× poverty line, n = 11	6.1 (2.1), 6 (4–8)		2.6, 0 (0–0.05)	
≤3× poverty line, n = 20	6.4 (2.1), 6 (5–9)		7.7, 0 (0–0.18)	
≤4× poverty line, n = 28	8.5 (3.0), 8 (6–11)		10.6, 0.071 (0–0.18)	
≤5× poverty line, n = 26	7.2 (2.8), 7 (5–8)		4.2, 0 (0–0)	
>5× poverty line, n = 60	7.7 (2.8), 8 (6–10)		8.6, 0 (0–0.14)	
Child severity of asthma				
Persistent, n = 57	7.6 (2.8), 7 (6–9)	.48	8.7, 0 (0–0.14)	.33
Intermittent, n = 130	7.4 (3.0), 7 (5–9)		7.3, 0 (0–0.14)	

[a] Lower adherence scores indicate better adherence.

[b] Wilcoxon rank sums test.

TABLE 3 Study Design

	CAM Use Year 0	CAM Use Year 1	Year 2
CAM use category 1	—	+	Adherence measured
CAM use category 2	—	—	Adherence measured

Asthma Medication Adherence

In our sample, the patients had high rates of adherence in general. The mean percent missed asthma daily controller medication doses per week was 7.7% (SD = 14.2%) for the entire cohort. For a patient using a controller medication twice a day, this translates to 1 missed dose a week. There were no consistent predictors of increasing nonadherence, based on demographic characteristics.

Adherence scores, defined as the sum of scores from the Medication Adherence Scale, ranged from 4 to 20, with lower scores reflecting higher adherence. Based on different demographic characteristics, the overall mean adherence score was 7.5 (SD = 2.9) for the entire cohort. As measured by percent missed doses as well as composite adherence score, adherence did not significantly differ with regard to demographic factors or asthma severity (Table 2).

Relationship Between CAM Use and Adherence

A multivariate linear regression model was designed to assess the effect of starting CAM or adding a new CAM modality (Table 3) on subsequent adherence to conventional asthma medications as measured by percent of missed asthma medication doses in a week. A separate multivariate linear regression analysis was completed by using adherence scores as the dependent variable. In both cases, the models were adjusted for severity of asthma, intervention/control status (data were taken from a randomized clinical trial designed to evaluate the effect of physician asthma education on provider management of asthma), clustering by provider, and percent of missed doses per week in year 1.

In the model, the initiation of CAM use was not significantly associated with subsequent adherence. Patients who used CAM (n = 34) missed a mean of 7.2% (95% confidence interval [CI]: 2–14.6) of doses per week, whereas patients who did not use CAM (n = 153) missed a mean of 6.5% (95% CI: 5.3–7.9) of doses per week. Similarly, composite mean adherence scores were 6.8 (95% CI: 5.9–7.8) and 7.3 (95% CI: 7.1–7.5), respectively, for the 2 groups (Table 4).

DISCUSSION

In contrast to previous cross sectional studies that suggested a link between CAM use and decreased adherence to asthma medications,[18,19] we found that CAM use does not affect future adherence with daily asthma medications. To our knowledge, this is the first study to examine this issue by using longitudinal data. In this data set, we were able to identify families who initiated CAM use for the first time and compare their subsequent conventional asthma medication adherence rates with those families who did not initiate CAM use.

One explanation for the lack of association between CAM initiation and subsequent conventional medical adherence is that children with asthma and their parents in this study sample view CAM as truly "complementary" and thus use it in an integrative manner, rather than as a replacement for conventional asthma treatments. Previous research has suggested that culturally specific belief systems regarding asthma often combine both biomedical and traditional concepts, suggesting that conventional medicine can be practiced alongside other health-care belief systems, such as CAM.[27] Parents may not consider the decision to use CAM as a choice between 2 disparate belief systems. For example, families may use relaxation techniques to help their child through an exacerbation while at the same time administering rescue medications.

As CAM use becomes more prevalent, it will become increasingly important for physicians who care for children to be aware of CAM use. The Awareness-Assessment-Negotiation Model suggests that providers should be aware of commonly held beliefs in their community, assess the likelihood that a particular patient may act on such beliefs during an illness, and be skilled at communicating and negotiating between different health systems.

After assessing a patient's health-related beliefs, 1 approach is to preface conversations about CAM use with general questions such as "Many families have heard about asthma remedies that are not prescribed by physicians. Have you ever heard of these kinds of remedies?" General questions can then be followed up with more specific questions such as "Have you ever tried those asthma remedies? How did it go?"[27] By

TABLE 4 Results of Multivariate Linear Regression Model Revealed No Relationship Between CAM Use and Adherence

CAM Use Category	CAM Use Year 0	CAM Use Year 1	Adherence Year 2	
			Adjusted percent missed doses/week (95% CI)	Adjusted adherence score (95% CI)
1 (n = 34)	—	+	7.2 (2.0–14.6)	6.8 (5.9–7.8)
2 (n = 153)	—	—	6.5 (5.3–7.9)	7.3 (7.1–7.5)

Model adjusted for severity of asthma, intervention/control status, and percent of missed doses in year 1 as well as clustering by provider.

approaching the subject in a stepwise manner, providers can set a nonjudgmental tone while gaining insight into patient belief systems.

Limitations

Despite a very large overall sample size (n = 1322) from which our data were extracted, the sample size used in this study was relatively small. This was in part due to the fact that we limited our study to 187 patients taking daily asthma medications for 3 consecutive years. This sample may have limited our power to detect differences in adherence rates between the 2 groups; however, the longitudinal design allowed us to examine CAM use and adherence in an appropriate temporal sequence.

Our study relied on caretaker self report of both adherence measures and CAM use. Although the Medication Adherence Scale used in the study has been shown to be reliable and valid, the authors of many studies have documented the tendency for patients to overestimate their adherence, and we did not use an electronic doser to validate parent-reported adherence.[9,28] Our adherence scores were high and may have overestimated actual adherence. In addition, we only collected data 1 year after the start of CAM therapy. It is possible that initially high adherence rates to conventional asthma medications may have waned over time.

Similarly, it has been well documented that patients often underreport their use of CAM. Because our study relied of self-report, we may have underestimated CAM use in our cohort. However, the most common reason for nondisclosure of CAM use is lack of direct questions from providers[29]; we asked about CAM use directly.

Finally, our data were taken from a predominantly white and college-educated sample of caretakers. Results may not generalize to other populations. Further study is warranted with a larger sample size and a more diverse patient population.

Implications

Notwithstanding these limitations, this study has important clinical implications. The suggestion that initiation of CAM use does not decrease future adherence to conventional asthma medications is encouraging. The data from this current study suggest that alternative or integrative medicine use is not necessarily "competitive" with conventional asthma therapies. As CAM use becomes more prevalent, it is important for physicians who care for children to ask about CAM use in a nonjudgmental fashion. Furthermore, as some CAM modalities have side effects and interactions with conventional medications, a collaborative approach can help avoid a situation where parents feel uncomfortable disclosing their CAM use to physicians. Conversely, because CAM users tend to report a positive effect after using CAM, physicians who are knowledgeable and supportive of the safe use of CAM may strengthen their therapeutic relationships with patients.

REFERENCES

1. Eisenberg DM, Kessler RC, Foster C, Norlock FE, Calkins DR, Delbanco TL. Unconventional medicine in the United States. Prevalence, costs, and patterns of use. *N Engl J Med*. 1993;328(4):246–252
2. Barnes PM, Bloom B, Nahin RL. Complementary and alternative medicine use among adults and children: United States, 2007. *Natl Health Stat Report*. 2008;12(12):1–23
3. Yussman SM, Ryan SA, Auinger P, Weitzman M. Visits to complementary and alternative medicine providers by children and adolescents in the United States. *Ambul Pediatr*. 2004;4(5):429–435
4. Ernst E. Prevalence of complementary/alternative medicine for children: a systematic review. *Eur J Pediatr*. 1999;158(1):7–11
5. Ottolini MC, Hamburger EK, Loprieato JO, et al. Complementary and alternative medicine use among children in the Washington, DC area. *Ambul Pediatr*. 2001;1(2):122–125
6. Pitetti R, Singh S, Hornyak D, Garcia SE, Herr S. Complementary and alternative medicine use in children. *Pediatr Emerg Care*. 2001;17(3):165–169
7. Wennergren G, Kristjánsson S, Strannegård IL. Decrease in hospitalization for treatment of childhood asthma with increased use of antiinflammatory treatment, despite an increase in prevalence of asthma. *J Allergy Clin Immunol*. 1996;97(3):742–748
8. Blais L, Beauchesne MF, Levesque S. Socioeconomic status and medication prescription patterns in pediatric asthma in Canada. *J Adolesc Health*. 2006;38(5):607.e9–607.e16
9. Rand CS, Wise RA. Measuring adherence to asthma medication regimens. *Am J Respir Crit Care Med*. 1994;149(2 pt 2):S69–S76; discussion S77–S78
10. Conn KM, Halterman JS, Lynch K, Cabana MD. The impact of parents' medication beliefs on asthma management. *Pediatrics*. 2007;120(3). Available at: www.pediatrics.org/cgi/content/full/120/3/e521
11. Chan PW, DeBruyne JA. Parental concern towards the use of inhaled therapy in children with chronic asthma. *Pediatr Int*. 2000;42(5):547–551
12. Handelman L, Rich M, Bridgemohan CF, Schneider L. Understanding pediatric inner-city asthma: an explanatory model approach. *J Asthma*. 2004;41(2):167–177
13. Horne R, Weinman J, Hankins M. The beliefs in medicines questionnaire: the development and evaluation of a new method for assessing the cognitive representation of medication. *Psychol Health*. 1999;14(1):1–24
14. Apter AJ, Boston RC, George M, et al. Modifiable barriers to adherence to inhaled steroids among adults with asthma: it's not just black and white. *J Allergy Clin Immunol*. 2003;111(6):1219–1226
15. Orrell-Valente JK, Jarlsberg LG, Rait MA, Thyne SM, Rubash T, Cabana MD. Parents' specific concerns about daily asthma medications for children. *J Asthma*. 2007;44(5):385–390

16. Braganza S, Ozuah PO, Sharif I. The use of complementary therapies in inner-city asthmatic children. *J Asthma*. 2003;40(7):823–827
17. Madsen H, Andersen S, Nielsen RG, Dolmer BS, Høst A, Damkier A. Use of complementary/alternative medicine among paediatric patients. *Eur J Pediatr*. 2003;162(5):334–341
18. Adams SK, Murdock KK, McQuaid EL. Complementary and alternative medication (CAM) use and asthma outcomes in children: an urban perspective. *J Asthma*. 2007;44(9):775–782
19. Roy A, Lurslurchachai L, Halm EA, Li XM, Leventhal H, Wisnivesky JP. Use of herbal remedies and adherence to inhaled corticosteroids among inner-city asthmatic patients. *Ann Allergy Asthma Immunol*. 2010;104(2):132–138
20. Horne R, Weinman J. Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. *J Psychosom Res*. 1999;47(6):555–567
21. Conn KM, Halterman JS, Fisher SG, Yoos HL, Chin NP, Szilagyi PG. Parental beliefs about medications and medication adherence among urban children with asthma. *Ambul Pediatr*. 2005;5(5):306–310
22. Orrell-Valente JK, Jarlsberg LG, Hill LG, Cabana MD. At what age do children start taking daily asthma medicines on their own? *Pediatrics*. 2008;122(6). Available at: www.pediatrics.org/cgi/content/full/122/6/e1186
23. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med*. 2005;353(5):487–497
24. McQuaid EL, Kopel SJ, Klein RB, Fritz GK. Medication adherence in pediatric asthma: reasoning, responsibility, and behavior. *J Pediatr Psychol*. 2003;28(5):323–333
25. Smith BA, Shuchman M. Problem of nonadherence in chronically ill adolescents: strategies for assessment and intervention. *Curr Opin Pediatr*. 2005;17(5):613–618
26. Cabana MD, Gollapudi A, Jarlsberg LG, Okumura MJ, Rait M, Clark NM. Parent perception of asthma control and complementary and alternative medicine use. *Pediatr Asthma Allergy Immunol*. 2008;21(4):167–172
27. Pachter LM, Weller SC, Baer RD, et al. Variation in asthma beliefs and practices among mainland Puerto Ricans, Mexican-Americans, Mexicans, and Guatemalans. *J Asthma*. 2002;39(2):119–134
28. Rand CS, Wise RA, Nides M, et al. Metered-dose inhaler adherence in a clinical trial. *Am Rev Respir Dis*. 1992;146(6):1559–1564
29. Sidora-Arcoleo K, Yoos HL, Kitzman H, McMullen A, Anson E. Don't ask, don't tell: parental nondisclosure of complementary and alternative medicine and over-the-counter medication use in children's asthma management. *J Pediatr Health Care*. 2008;22(4):221–229

Complementary and Alternative Medicine Use and Adherence With Pediatric Asthma Treatment

Julie C. Philp, Judy Maselli, Lee M. Pachter and Michael D. Cabana

Pediatrics 2012;129;e1148
DOI: 10.1542/peds.2011-2467 originally published online April 9, 2012;

PEDIATRICS®
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Complementary and Alternative Medicine Use and Adherence With Pediatric Asthma Treatment

Julie C. Philp, Judy Maselli, Lee M. Pachter and Michael D. Cabana

Pediatrics 2012;129;e1148
DOI: 10.1542/peds.2011-2467 originally published online April 9, 2012;